Claims

[c1] In a diagnostic X-ray system generating a plurality of image frames at varying frame rates, a method to minimize signal conversion time for a solid-state detector panel of said X-ray system, said method comprising:
measuring a set of induced signal offsets, whether positive or negative, caused by time varying charge retention associated with said detector panel during a phantom time segment prior to normal signal readout of said detector panel for a current image frame;
generating a set of adjustment values in response to said set of induced signal offsets; and
reading out subsets of signal values of said detector panel to a pre-determined signal dynamic range as part of said normal signal readout of said detector panel in response to said set of adjustment values, thus generating a set of normalized detector signals.

[c2] The method of claim 1 wherein said generating said set of adjustment values comprises indexing into at least one look-up-table (LUT) and reading said adjustment values from said at least one LUT prior to said normal signal readout of said detector panel for said current image frame, said at least one LUT being previously generated based on, at least in part, a prior characterization of panel charge retention as a function of said subsets and frame rate.

[c3] The method of claim 1 wherein said generating of said set of adjustment values comprises computing said set of adjustment values prior to said normal signal readout of said detector panel for said current image frame, said computing being based on, at least in part, a prior characterization of panel charge retention as a function of said subsets and frame rate.

[c4] The method of claim 1 wherein said reading out comprises adjusting a signal gain value and/or shifting a starting value of a signal conversion ramp, for each subset of said subsets of signal values based on said adjustment values, during a signal conversion time segment of said normal signal readout such that each of said set of normalized detector signals falls within said pre-determined

signal dynamic range for said current image frame.

[c5] The method of claim 1 wherein said reading out comprises adjusting at least one signal gain and/or offset value corresponding to a first subset of photodiode/transistor pairs of said detector panel, wherein said first subset is currently being read out during a signal acquisition time segment of said normal signal read-out and corresponds to a subset of said subsets of signal values, and applying at least one adjustment value to a second subset of photodiode/transistor pairs of said detector panel, wherein said second subset is not currently being read out, such that each of said set of normalized detector signals corresponding to said first subset falls within said pre-determined signal dynamic range for said current image frame.

[c6] The method of claim 1 wherein any subset of said subsets of signal values of said detector panel corresponds to charges built up on at least one row of photodiode/transistor pairs of said detector panel.

[c7] The method of claim 1 wherein said charge retention comprises switching charge retention caused by switching field-effect-transistors on and off in said detector panel.

[c8] The method of claim 1 wherein said charge retention comprises photo-conductive charge retention caused by photon signals impinging upon photodiodes in said detector panel.

[c9] The method of claim 1 wherein said charge retention comprises both switching charge retention caused by switching field-effect-transistors on and off in said detector panel and photo-conductive charge retention caused by photon signals impinging upon photodiode/transistor pairs in said detector panel.

[c10] In a diagnostic X-ray system generating a plurality of image frames at varying frame rates, apparatus to minimize signal conversion time of said X-ray system, said apparatus comprising:
a scintillator converting X-ray signals to photon signals;
an array of photodiode/field-effect-transistor pairs abutting said scintillator and being responsive to said photon signals to affect charge build-up in said

array; and

read-out electronics to read a current row of said array to be read, said read-out electronics being connected to columns of said array and being responsive to said charge build-up to generate a set of normalized detector signals such that said set of normalized detector signals is adjusted for offsets in signal strength, whether positive or negative, caused by temporal row-to-row variations in charge retention in said array.

[c11] The apparatus of claim 10 wherein said read-out electronics comprises:

a set of signal integrator/sample-and-hold circuits responsive to a signal value and changes in said charge build-up along columns of said array to generate a corresponding set of integrated signals being proportional to said changes in charge build-up for each of said photodiode/field-effect-transistor pairs in said current row being read out;

a digital counter responsive to a clock signal and a row variable offset value to generate an offset signal conversion ramp for said current row being read out and wherein said offset signal conversion ramp is derived from a single, pre-determined signal conversion ramp that is common for all rows to be read out;

a corresponding set of comparators responsive to said corresponding set of integrated signals and to said offset signal conversion ramp to generate a corresponding set of latch signals when said corresponding set of integrated signals is equal to or greater than a current level of said offset signal conversion ramp for said current row being read out; and

a corresponding set of data registers responsive to said offset signal conversion ramp and said corresponding set of latch signals to capture said set of normalized detector signals in said corresponding set of data registers for said current row being read out.

[c12] The apparatus of claim 11 further comprising a first digital-to-analog converter responsive to a digitized version of said offset signal conversion ramp to generate an analog version of said offset signal conversion ramp for said current row being read out.

[c13] The apparatus of claim 11 further comprising a second digital-to-analog

converter responsive to a digital version of said signal value to generate an analog version of said signal value for said current row being read out.

[c14] The apparatus of claim 11 wherein said row variable offset value offsets said pre-determined signal conversion ramp such that said corresponding set of integrated signals falls within the dynamic range of said offset signal conversion ramp for said current row being read out.

[c15] The apparatus of claim 11 further comprising at least one look-up-table (LUT) storing in a memory a single, predetermined set of row variable offset values wherein said row variable offset value for said current row being read out is generated by indexing into said at least one LUT based on taking at least one phantom measurement of said array prior to normal signal readout of said array.

[c16] The apparatus of claim 10 wherein at least one row variable offset value is computed for said current row to be read out based on taking at least one phantom measurement of said array prior to normal signal readout of said array.

[c17] The apparatus of claim 10 wherein at least one row variable offset value is applied to field-effect-transistors of at least one row of said array during an acquisition time segment of said current row being read out during normal signal readout, said at least one row being a different row than said current row being read out.

[c18] The apparatus of claim 10 wherein said charge retention comprises switching charge retention due to field-effect-transistors in said array switching on and off.

[c19] The apparatus of claim 10 wherein said charge retention comprises photo-conductive charge retention caused by said photon signals.

[c20] The apparatus of claim 10 wherein said charge retention comprises both switching charge retention due to field-effect-transistors in said array switching on and off and photo-conductive charge retention caused by said photon

signals.

[c21] A diagnostic X-ray system for generating and displaying a plurality of image frames corresponding to internal structure of a subject, said diagnostic X-ray system comprising:
an X-ray tube for generating X-ray signals;
a solid-state detector module responsive to said X-ray signals and generating a plurality of charges representative of charge retention and X-ray intensity; and
an image processing module responsive to said plurality of charges and generating a plurality of normalized detector signals for a current image frame, said normalized detector signals being dynamically adjusted for variations in charge retention, whether positive or negative, as frame rate changes.

[c22] The diagnostic X-ray system of claim 21 further comprising a collimator to direct said X-ray signals towards said solid-state detector module.

[c23] The diagnostic X-ray system of claim 21 further comprising a detector controller module interfacing to said image processing module and said solid-state detector module to provide control signals to said image processing module and said solid-state detector module.

[c24] The diagnostic X-ray system of claim 21 further comprising a system controller interfacing to said image processing module and a detector controller module to provide system control signals to said image processing module and said detector controller module.

[c25] The diagnostic X-ray system of claim 21 further comprising a monitor interfacing to said image processing module for displaying said normalized detector signals to a user of said system.

[c26] The diagnostic X-ray system of claim 21 wherein said charge retention comprises switching charge retention caused by switching field-effect-transistors on and off in said detector panel.

[c27] The diagnostic X-ray system of claim 21 wherein said charge retention comprises photo-conductive charge retention caused by photon signals

impinging upon photodiodes in said detector panel.

[c28] The diagnostic X-ray system of claim 21 wherein said charge retention comprises both switching charge retention caused by switching field-effect-transistors on and off in said detector panel and photo-conductive charge retention caused by photon signals impinging upon photodiodes in said detector panel.